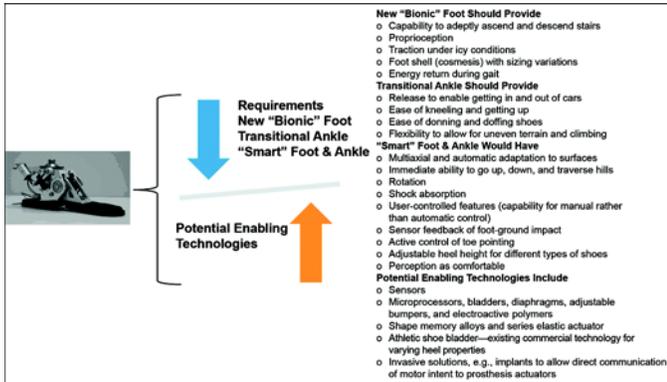


Lower-limb amputee needs assessment using multistakeholder focus-group approach

Glenn K. Klute, PhD, et al.



We are rightly concerned about translating research from the bench to the bedside; how concerned are we about translating needs from the bedside to the bench? We held a 2-day needs-assessment workshop, with veteran lower-limb prosthetic users, clinicians, researchers, and prosthetic device manufacturers in attendance. Ideas to refine socket and suspension systems, prosthetic feet and ankles, prosthesis alignment, and remote monitoring systems all emerged as areas in which next generation prostheses might improve the lives of all amputees. Education and mentoring might also play a role in improving lives by providing a better understanding of the recovery path following amputation.

Assessing the state of clinically applicable research for evidence-based practice in prosthetics and orthotics

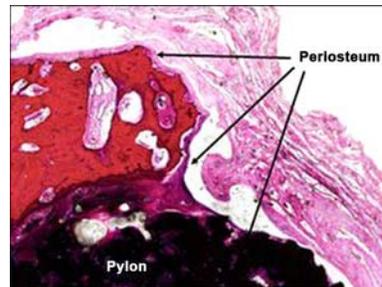
Mark D. Geil, PhD

Evidence-based practice (EBP) combines a practitioner's training and experience with evidence established

through scientific research. EBP cannot improve patient care unless quality evidence exists and practitioners know how to use it. This article reviews research that has been successfully applied to practice in the past, sometimes producing substantial changes. In addition, obstacles remaining in the ongoing application of research to practice are identified. Practitioners have stated a desire for research and have identified a list of research needs but lack the training or resources necessary to conduct the research. A gulf also exists between the perceived research needs and the clinically applicable research that is being produced, possibly due to the broad nature of those needs.

Mathematical modeling and mechanical and histopathological testing of porous prosthetic pylon for direct skeletal attachment

Mark Pitkin, PhD, et al.



The increased number of young, active individuals with amputation due to recent wars has focused more attention on direct skeletal attachment of limb prostheses. This article deals with the further develop-

ment of the totally porous composite pylon for direct skeletal attachment. The minimum strength requirements established from the gait biomechanics data have been exceeded threefold. The histopathological analysis provides new evidence of inflammation-free deep ingrowth of skin and bone cells throughout the totally porous structure. These results may lead to the development of a pylon for safe and long-lasting direct skeletal attachment.

One hundred patients treated with osseointegrated transfemoral amputation prostheses—Rehabilitation perspective

Kerstin Hagberg, RPT, PhD; Rickard Brånemark, MD, PhD

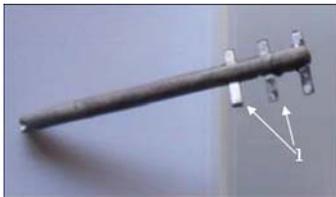


Treatment for bone-anchored prostheses using osseointegration has been performed in Sweden since 1990. Treatment comprises two surgery sessions followed by rehabilitation with gradually increased prosthetic activity. The total treatment period is about 12 months. We present the development of the rehabilitation protocol and an overview of the results. To date, 100 patients with transfemoral amputations, mostly because of trauma or tumor, have been treated. The majority of failures belong to patients treated before we established the current rehabilitation protocol. By reducing

the number of socket-related problems, this treatment can make everyday life easier for an increasing number of patients with amputations.

On the way to total integration of prosthetic pylon with residuum

Mark Pitkin, PhD

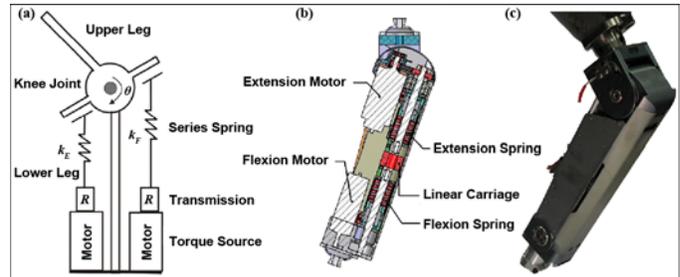


The number of young, active individuals with amputation has increased because of recent wars, and this increase has directed more attention to the technology of direct

skeletal attachment of limb prostheses. In this article, I provide a multidisciplinary revisiting of all aspects of the technology that is responsible for life-long safe functioning.

Agonist-antagonist active knee prosthesis: A preliminary study in level-ground walking

Ernesto C. Martinez-Villalpando, SM; Hugh Herr, PhD



In contrast to traditional purely dissipative prosthetic knees, we propose a biomimetic variable-impedance knee prosthesis with two series-elastic actuators arranged in parallel in an agonist-antagonist architecture. The prosthesis mimics human knee mechanics during level-ground walking, even though the motors of the prosthesis never perform positive work throughout the gait cycle. Because of the variable-impedance nature of the prosthesis, electrical power requirements for walking are modest, allowing for an energetically economical powered knee system. The objective of this adaptive powered knee prosthesis is to improve gait and metabolic energy consumption of transtibial amputees on various terrain conditions.

Transtibial amputee joint rotation moments during straight-line walking and a common turning task with and without a torsion adapter

Ava D. Segal, MS, et al.



Walking at home and in the community requires frequent turning and twisting maneuvers. For veteran amputees who

wear lower-limb prostheses, these activities can transmit large torsional loads onto the skin of their residual limb, which may contribute to discomfort and injury. This study showed that a torsion adapter, a springlike device mounted between the prosthetic socket and pylon, minimally affected transmitted torsional loads when an individual walked in a straight line. However, when the individual performed a turning maneuver, the torsion adapter reduced the transmitted torsional load compared with a standard rigid adapter. These results suggest that torsion adapters may benefit veteran lower-limb amputees walking in a household environment.

Early delayed amputation: A paradigm shift in the limb-salvage time line for patients with major upper-limb injury

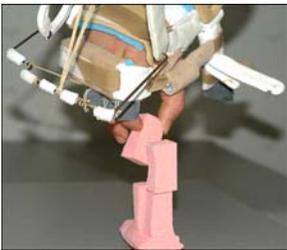
Todd E. Burdette, MD, et al.



Patients with major upper-limb injuries often choose limb-salvage surgery, but sometimes they end up with a useless, painful, or stiff limb that functions poorly. They may then choose amputation and a prosthesis, hoping for improved function. We present three patients who chose amputation 6 months after their injury. Surgeries were unable to salvage a useful limb for them. They all waited another 4 to 6 months before an amputation was performed. In retrospect, they each regret the additional waiting for the amputation. We propose that limb-salvage patients should be offered the choice of amputation 6 months after their injury—a time line change that may avoid unnecessary surgery and relieve suffering for those who are unhappy with their injured limbs.

A new option for amputees: Transplantation of the hand

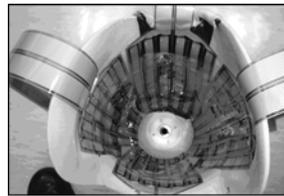
Christina L. Kaufman, PhD, et al.



The advancements in prosthetics are truly remarkable. However, people living with amputation of the hand should be aware of another option. In Louisville, Kentucky, we are recruiting patients for a clinical trial of composite tissue allotransplantation of the hand. We have performed the only 5 hand transplants in the United States out of a total of 44 transplants that have been performed worldwide. Our patients are doing well and enjoying life with their transplanted hand/forearm. Significant risks are associated with this procedure that must be understood. Hand transplantation is not for everyone, but it is an option that can be considered by select patients.

Dynamic interface pressure distributions of two transtibial prosthetic socket concepts

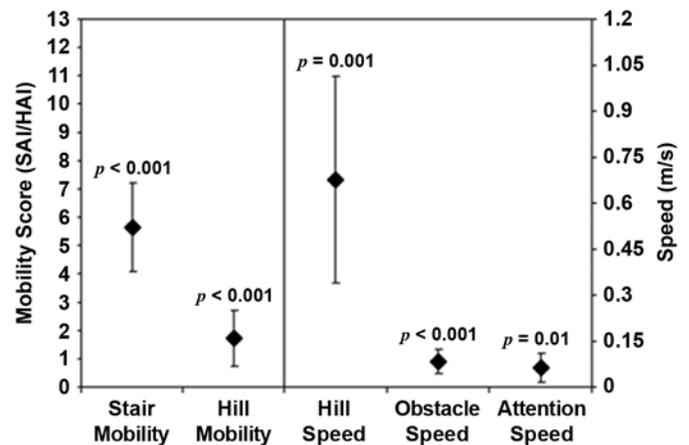
Tim Dumbleton, BSc, et al.



Two prosthetic socket concepts (hand-cast and pressure-cast) are in regular use in prosthetic clinics. A key factor in the success of treatment is the interface pressure between the prosthetic socket and residual limb. We investigated and compared the dynamic interface pressure distribution of hands-off and hands-on transtibial prosthetic systems by means of pressure mapping. Interface pressures were found to have similar distributions for these two different casting concepts. This finding would suggest that both types of prosthetic socket can provide equally good comfort. Facilities may specialize in only one of the socket concepts, and knowing that their choice of specialization does not in itself affect the prospect for success of prosthetic treatment is important.

Differences in function and safety between Medicare Functional Classification Level-2 and -3 transfemoral amputees and influence of prosthetic knee joint control

Brian J. Hafner, PhD; Douglas G. Smith, MD



Advanced prosthetic technology, often recommended for younger, more active people with amputation, may also greatly benefit those who are older and more limited by their disability. This research found that, like active users, limited users also receive functional benefits when walking on level ground, stairs, hills, and uneven terrain

while using a microprocessor-controlled prosthesis. Using this type of prosthesis, less active users also experienced fewer falls and reported increased confidence. Because these individuals represent the majority of veterans with amputation, these study results suggest that advanced prosthesis technology has great potential for improving their real-world function and personal safety.

Walking mechanics of persons who use reciprocating gait orthoses

William Brett Johnson, BE, et al.

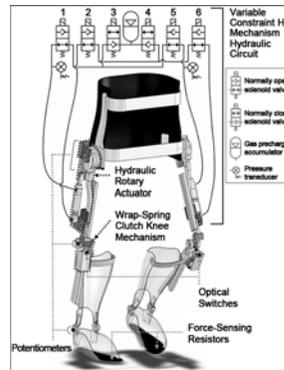


Although walking with reciprocating gait orthoses (RGOs) may physiologically benefit people with lower-limb paralysis, the high energy cost associated with orthotic ambulation limits use. We conducted this study to measure users walking with RGOs to identify and better understand the potential causes of the high energy cost. Walking was measured in five regular users of RGOs. The results suggest that characteristics of walking with RGOs, such as trunk posture and arm loading, are consistent across users. RGO users' arms bear a large proportion of body weight, and forward bending of the trunk may encourage arm loading. This arm loading likely contributes to the high energy cost of walking with RGOs, since studies have shown that upper-body muscles produce power less efficiently than lower-body muscles. The relationship between posture,

arm loading, and the action of the RGO reciprocal link should be further explored.

Development of hybrid orthosis for standing, walking, and stair climbing after spinal cord injury

Rudi Kobetic, MS, et al.



Access to different environments and negotiating architectural barriers in the home, workplace, and community remain problems for veterans with paraplegia despite advances in medicine and the passage of the Americans with Disabilities Act. This study examines the feasibility of a hybrid system combining new bracing components that automatically lock and unlock to

regulate movement with functional electrical stimulation of the user's own paralyzed muscles to power movement of the legs. This article summarizes the design requirements for the orthosis and details the preliminary performance of a prototype hybrid system that enables users to stand up from sitting, maintain upright standing, walk, and climb stairs. Results are presented from bench testing, laboratory evaluation on nondisabled individuals, and initial testing with a volunteer with SCI. Further development of hybrid systems should provide greater accessibility for persons with SCI to places not readily reachable from the wheelchair while helping to reverse the degradation of bones, joints, heart, lungs, and skin due to the immobility from paralysis.